California Institute of Technology

NASA Sensors For CounterTerrorism

Merle McKenzie

Minoo Dastoor

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Needs For Sensors In Counterterrorism: High Level Examples

- **Detection, Measurement And Characterization Of Chemical, Radiological, Biological And Toxic Industrial Agents**
  - **Entry Point Screening Systems To Detect Biological/Chemical Devices**
  - **Rapid Warning Of Pre-Release Biological, Chemical, Or Toxic Industrial Chemicals**
  - **Systems To Locate Source Of Released Agents**
- **Long-Range Monitoring Of Geographic Areas**
- **Platforms To Deploy Sensors**
- **Support Systems**
  - **Communications**
  - **Data Mining And Analysis**
  - **Simulation And Modeling**
  - **Warning Systems**
  - **Response Planning**

NASA Sensor Technology Areas: NASA Interests In Partnering

Explosives And Vapor Detection

- **Imaging Technologies**
  - **Near/Mid-Term**
    - **Reverse Geometry X-Ray**
    - **UV Induced Fluorescence**
  - **Far-Term**
    - **Terahertz Electromagnetic Imaging**
- **Miniature Mass Spectrometry**
  - **Near/Mid-Term**
    - **Quadrupole Mass Spectrometer Array**
    - **Paul Ion Trap**
      - **Both With Miniature Gas-Chromatograph Front End**
    - **Reversal Electron Attachment Detector (READ)**
- **Raman Spectroscopy**
  - **Near/Mid-Term**
    - **Mars Microbeam Raman Spectrometer**
    - **UV Resonance Raman Spectrometer**

NASA Sensor Technology Areas: NASA Interests In Partnering

Chemical Detectors

- **Smart Micro/Nano Sensors**
  - **Near/Mid-Term**
    - **Electronic Nose**
    - **Sensor Webs**
- **Far-Term**
  - **Integrated Advanced Sensing, Imaging And Monitoring Techniques Into Micro-Robots**
- **IR Gas Correlation/Differential Absorption Spectroscopy (Near/Mid-Term)**
- **Infrared Laser Radar (IR-Lidar)**
  - **Far-Term**
    - **Tunable Infrared Lasers**

NASA Sensor Technology Areas: NASA Intersts In Partnering

Biological Detection:

Collection And Concentration Of Samples Is An Issue

- **Near/Mid-Term**
  - **o Expertise In Miniaturization And Systems Integration Can Advance The State Of The Art**
- **Far-Term: Modification Of Detectors For Explosives And Chemical Agents**
  - **o UV Induced Fluorescence**
  - **o Chemiluminescence**
  - **o Miniature Mass Spectrometry With READ Interface**
  - **o New Smart Sensors Directed Toward Quantum Effects**

Examples of NASA Sensor Technology

- **Miniature Mass Spectrometers: Jet Propulsion Laboratory**
- **Miniature Reversal Electron Attachment (READ): Jet Propulsion Laboratory**
- **Sensor Webs: Jet Propulsion Laboratory**
- **Aircraft Systems Hardening: Distributed Multifunctional Sensor System For Air Quality Monitoring And Real-Time Cabin/Cargo Bay Surveillance: Glenn Research Center**
- **Airport Security Protections: Smart Micro/Nano Sensor For Integrated Chemical, Biological, And Explosive Detection: Glenn Research Center**
- **Mobile Sensing Platform For Improved Baggage Inspection: Glenn Research Center**
- **Remote Chemical Detection: Langley Research Center**

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Points Of Contact At NASA

NASA Headquarters	Minoo Dastoor	202-358-4518
Ames Research Center	Carolina Blake	650-604-1754
Dryden Flight Research Center	Jenny Baer-Riedhart	661-276-3689
Goddard Space Flight Center	Nona Minnifield Cheeks	301-286-8504
Jet Propulsion Laboratory	Merle McKenzie	818-354-2577
John H. Glenn Research Center	Larry Viterna	216-433-3484
Johnson Space Center	Charlene Gilbert	281-483-0474
Kennedy Space Center	James Aliberti	321-876-6224
Langley Research Center	Wilson Lundy	757-864-6005
Marshall Space Flight Center	Vernotto McMillan	256-544-2615
Stennis Space Center	Kirk Sharp	228-688-1914

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NCTMT Quarterly

NCTMT National Security / Counterterrorism Activity

Merle McKenzie
August 16, 2002

Topics

- **Status**
- **New Security Lead for NASA**
- **Current Plan**
- **Membership on the NCTMT Security / Counterterrorism Subteam**

Plan for FY02

For the National Security/Counterterrorism Support Work by the Commercial Technology Network for Various Enterprises

1. Choose sub-area for FY02 sensors
2. Determine the interests of the codes
   - R: NASA/FAA agreement
     i. Sensors
   - S: Will support discussions with other Federal Agencies
     i. Sensors
   - Y: tbd
3. Determine interest of Code A
   - Want a NASA-wide effort regarding technology – not sure what yet
   - Support Center efforts
4. Decision: for FY02 remainder
   - Acquire technology lists from all Centers
   - Do a technology assessment on sensors proposed by Centers
   - Compare NASA technologies to those on the market; those being developed
   - Concurrently, continue to research
     i. Federal funding
     ii. Goals of Agencies
     iii. Use needs especially first responders
   - Report to the Codes and NASA HQ on: What NASA has to offer in sensors to the other agencies
     1) Individual technologies
     2) Clustered technologies
     3) Clustered capabilities
   - Concurrently, begin outreach to companies so that they know what NASA has to offer

Status

- Chose "Sensors" as first Technology (for FY02)
- Determined interests of some Codes
  - Code R: NASA/FAA Agreement which is proceeding
  - Code S: Will support NCTMT in working with other agencies
  - Code A: New Leader is Dr. Amy Donohue
- Received sensor technology lists from 4 Centers
- Received technology assessments on 3 JPL test cases
- Will receive Partner Assessments on test cases
- Continue to Research: funding, requirements, first responder community
- Began outreach to companies at the NASA Sensor Conference

Encouraging News

- Great connections through the Network assets
  - MCRTTC: the National Emergency Response Training Center
    - Fire-fighter training – specialty teams
    - Facility for terrorism scenario simulation: 30 buildings
    - Possible test-bed for new technologies
  - NERTTC
    - Critical Incident Command
    - Facial/Biometric Recognition (through an SBIR company)
    - All RTTC-FLC Firefighters Initiative
  - NTTC
    - FEMA technology transfer responsibility
    - NIJ spin-off
  - L.A. County Terrorism Early Warning Group (TEWG) through JPL Testbed MOU
  - Strong technologies and experience in the Centers
    - JSC: Firefighter suits, Communications, etc.
    - GSFC: Earth Alert System, etc.
    - AMES: Aeronautics applications, Re-hydration systems, NASA Research Park, etc.
    - LaRC: Aeronautics applications, sensors, etc.
    - Glenn: Aeronautics applications, sensors, etc.
    - JPL: Sensors, robotics, work for Federal Agencies, etc.
    - ETC! All Centers do have technology, capability, and aystems abilities to offer

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Minoo Dastoor

July 29-30, 2002
Baltimore, Md

This work was performed at and under the direction of the Jet Propulsion Laboratory, California Institute of Technology under a contract with the National Aeronautics and Space Administration.

Generic Sensor Architecture

Alarm

Electronic Nose

Particle Counter

Fluorescence

Detection Systems

Analysis

Biological:
DNA / Protein / Antibody / Tissue

Chemical:
MS / IS / IR / SAW / Raman

- **Miniature**
- **Distributed**
- **Autonomous**
- **Real Time**
- **Continuous**
- **Cheap**
- **Networked**

- **High precision**
  - **Chemical: ppb-ppt**
  - **Biological: ~10 cells/well**
- **Rapid [1-2 hrs]**
- **Medically Safe**
- **Automated Sample Collection & Preparation**
- **Human-Centered Output**

NASA Sensor Technology Areas: NASA Interests In Partnering

Explosives And Vapor Detection

- Imaging Technologies
  - Reverse Geometry X-Ray (Near/Mid-Term)
  - UV Induced Fluorescence (Near/Mid-Term)
  - Terahertz Electromagnetic Imaging (Far-Term)
- Miniature Mass Spectrometry
  - Quadrupole Mass Spectrometer Array (Near/Mid-Term)
  - Paul Ion Trap (Near/Mid-Term)
    - Both With Miniature Gas-Chromatograph Front End
  - Reversal Electron Attachment Detector (READ) (Near/Mid-Term)
- Raman Spectroscopy
  - Mars Microbeam Raman Spectrometer (Near/Mid-Term)
  - UV Resonance Raman Spectrometer (Near/Mid-Term)

NASA Sensor Technology Areas: NASA Interests In Partnering

Chemical Detectors

- Smart Micro/Nano Sensors
  - Electronic Nose (Near/Mid-Term)
  - Sensor Webs (Near/Mid-Term)
  - Integrated Advanced Sensing, Imaging and Monitoring Techniques onto Micro-Robots (Far-Term)
- IR Gas Correlation/Differential Absorption Spectroscopy (Near/Mid-Term)
- Miniature Mass Spectrometry with The Paul Ion Trap and the READ Front End (Near/Mid-Term)
- Infrared Laser Radar (IR-LIDAR)
  - Tunable Infrared Lasers (Far-Term)

NASA Sensor Technology Areas: NASA Intersts In Partnering

Biological Detectors:

Collection and concentration of samples is an issue

- Expertise in miniaturization and systems integration can advance the state of the art
- Modification of chemical and explosives detectors for biologic agents (Far-Term)
  - o UV Induced Fluorescence
  - o Chemiluminescence
  - o Miniature Mass Spectrometry with READ Interface
  - o New smart sensors directed toward Quantum effects

Examples of NASA Sensor Technology

Goddard Space Flight Center

Capaciflector-based Technology For Advanced Capacitive Sensing:
Self-sensing System For Clandestine Security

Multifrequency-scanning Capaciflector:
Sensor Applicable To Weapon Or Explosive Detection; Motion Detection

UV Laser Micro-machining Of Micro-Well Detectors:
Inspection, Monitoring Of Radioactive Material; Environmental Monitoring; Food Inspection

Cadmium Zinc Telluride Strip Detectors And Detector Arrays:
Baggage Scanners, Nuclear Surveillance, Environmental Monitoring

MEMS Fabry-Perot Tunable Filter For Near-Infrared Imagery:
Material Composition; Composite Material Identification

Integrated Sol-gel Fiber Optic Device For Space Flight
Biohazard Analysis

Jet Propulsion Laboratory

Miniature Mass Spectrometers:
Explosive, Chemical, And Potential Biological Agent Detection

Miniature Reversal Electron Attachment (READ) For Generating Near Zero-energy Electrons At A Target Gas Beam
Front-end For Mass Spectrometers To Detect Explosive, Nerve, And Blister Agents

Sensor Webs:
A System Of Distributed, Heterogeneous Sensors For Hazard Detection In Hostile Environments

Examples of NASA Sensor Technology (Continued)

John H. Glenn Research Center at Lewis Field

Aircraft System Hardening
Distributed Multifunctional Sensor System For Air Quality Monitoring And Real-time Cabin/Cargo Bay Surveillance

Airport Security Protections:
Smart Micro-nano Sensor For Integrated Chemical, Biological, And Explosive Detection

Mobile Sensing Platform
Improved Baggage Inspection Through Sensor Arrays Tailored To Security Needs

Langley Research Center

Chemical Weapons Detector:
A Gas Filter Correlation Radiometer

Personal Emergency Beacon Receiver (Motorola Co-Invention)

New Security Lead for NASA

Amy Donahue

How to advise OK ~~others~~ what to do.

Wants:
(1) What do we have?
(2) What can it offer?
(3) What could we do @ resources

Work @
(1) 10 Centers
(2) Code I (eg. Tech Companion)
(3) Other Agencies

Plan for FY03

- **Re-initiate the Team**
  - **Members**
  - **Goals and Plans**
    - **Technology**
    - **Market position**
    - **Potential partners**
    - **Engage Codes I, A, S, R, T, . . .**
    - **Find funding**
    - **Develop partnerships**
  - **Coordinate with Enterprise Agreements/Activities**
  - **Coordinate with Marketing Team efforts**

Participants So Far
(not comprehensive list)

Ames:	Carolina Blake
Dryden:	Yvonne Kellogg
GSFC:	Nona Cheeks / Monica Montague
JPL:	Merrilee Fellows
Glenn:	Larry Viterna / Bill Saettel
JSC:	Jim Aliberti
KSC:	Preston Carraway / Rheal Turcotte / Marisol Garcia
MSFC:	Vernatto McMillan
Stennis:	Kirk Sharp
HQ:	Michael Weingarten
NTTC:	Joe Allen / Malcolm Webster
FWRTTC:	Ken Dozier / Marty Zeller
MidQtlantic RTTC:	Charlie Blankenship
Mid-Continent RTTC:	Gary Seral
Midwest RTTC:	Pierrette Woodford / David Salay
Northwest NTTC:	Tom Kennedy
Southeast RTTC:	David Bridges
RTI:	Dan Winfield / Gary Hughes

Please verify your interest